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J.G. Harrar

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MEXICAN AGRICULTURAL PROGRAM

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MEXICAN AGRICULTURAL PROGRAM

A Review of the First Six Years of Activity under the Joint Auspices of the Mexican Government and The Rockefeller Foundation

By

J. G. HARRAR

NEW YORK, 1950.

THE MEXICAN AGRICULTURAL PROGRAM

THIS is the story of a project in international cooperation. The Mexican Agricultural Program was initiated in February of 1943 as a joint undertaking of The Rockefeller Foundation and the Mexican Department of Agriculture, the goal being to improve the productivity of Mexico's agriculture. Then, for the first time in its history, The Rockefeller Foundation sent agricultural specialists into a foreign land to work side by side with the scientists of that country in raising the level of national food production. This objective is not unlike those of other Foundation projects dealing with public health improvement; indeed, the purpose may be regarded as a parallel one, since nutrition is closely related to health. But it is not only adequate nutrition and good health that depend upon the yield of Mexico's farms. The whole Mexican economy rests on this output, and no enterprise is more basic to the national welfare than the improvement of agriculture.

The project was not undertaken hastily. For several years, Foundation officers had been thinking of the importance of agriculture as one of the essential activities in improving nutrition. In 1941, when Mr. Henry A. Wallace was Vice-President of the United States, he remarked in a conversation with Mr. Raymond B. Fosdick, then President of the Foundation, that in his opinion the whole economic status of Mexico could be altered for the better if some organization would assist agricultural improvement there. President Fosdick was impressed with this idea and shortly thereafter discussed with the staff what steps might be taken.

Although a project in agriculture represented a departure from current policy, it was by no means a surprising deviation. The Rockefeller boards had previously had agricultural interests in Europe; and for some time a fundamental approach to human health and welfare through better nutrition resulting from the greater production of quality foods had been under consideration. In consequence, increased support had been going to biochemists, physiologists and geneticists. The opportunity to pioneer a program unlike any other anywhere, with elements of modern agriculture, the biochemistry of nutrition, social science and international relationships involved, had great appeal. It suggested the possibility of a real contribution, and the establishment of a new pattern for Rockefeller Foundation operation in the field of nutrition.

As a first step, the Foundation asked a committee of three distinguished agricultural scientists to spend several months on a reconnaissance tour of Mexico. Their job was to report on the desirability as well as the feasibility of starting a Rockefeller Foundation sponsored program in Mexico. The chairman of the committee was Dr. E. C. Stakman, Chief of the Division of Plant Pathology of the University of Minnesota. He was accompanied by Dr. Paul C. Mangelsdorf, Director of the Botanical Museum, Harvard University, and Dr. Richard Bradfield, Head of the Department of Agronomy, Cornell University.

During the summer crop season of 1941, these three specialists traveled some 5,000 miles in Mexico, visiting more than half of its 28 states. They investigated the characteristic crops of the various regions, and in trying to evaluate Mexican agriculture against its background of climates, soils, traditions and customs, talked with all kinds of people from peons to high government officials.

The report was favorable. Dr. Stakman and his colleagues expressed the conviction that the Foundation could render unusually effective service to the cause of human welfare through basic agricultural studies in Mexico. It was their idea, too, that such studies might prove of significance not only to Mexico but also to other Latin American countries.

Almost at once the Mexican Government issued a cordial invitation to The Rockefeller Foundation to launch a cooperative agricultural program in Mexico. The Foundation accepted this invitation in the fall of 1942, and the program was started officially in February 1943. At that time a formal agreement was signed between the

Experimental field work of the Mexican Agricultural Program centers at Chapingo, seat of the National College of Agriculture. The field laboratory and greenhouse serve some 260 acres of trial plantings as well as experiments in other parts of the country.

An important adjunct to field work is the plant pathology laboratory located in the Office of Special Studies at San Jacinto, Mexico City.

two agencies, former Secretary of Agriculture Marte R. Gómez representing the Government of Mexico, and Dr. Harry M. Miller, Jr., The Rockefeller Foundation.

Administrative responsibility for the program within The Rockefeller Foundation was assigned to the Natural Sciences division headed by Dr. Warren Weaver. The original committee of three which had made the survey became the Advisory Committee for Agricultural Activities. The Field Director selected for the new program was Dr. J. G. Harrar, then head of the Department of Plant Pathology at Washington State College; he had previously had teaching and field experience at the University of Puerto Rico and spoke Spanish fluently.

From the standpoint of the Mexican economy the timing of the program could scarcely have been more propitious. While basic food crop production had been dropping, new industrial development was beginning to make greater demands on national labor. What Mexico needed was more food of high quality for all the people, produced with less labor. A real difficulty was the relatively small amount of available arable land. Only 7.4 per cent of Mexico's 758,057 square miles represents cropland, and four fifths of this is classed as semiarid. Nevertheless, in spite of the small area of productive land available for the growing of many basic crops, there is reason to believe that the land resources are adequate; if well managed, they may supply all the needs of the people at a standard of living much higher than at present and at the same time provide a surplus of several crops for export.

Modern technology provides ways of solving agricultural problems. Crop production research in the United States and elsewhere gives some idea of what can be accomplished through a concerted attack involving soil management, conservation methods, the development of better crop varieties, pest control, irrigation, the introduction of modern farm machinery and other aids which make for greater yield and more efficient use of labor. Although the Mexican program could not be expected to use all these methods at once, it was felt that more basic research might well result in new information, methods and seed varieties directly applicable and of real and immediate benefit to Mexican agriculture.

Members of the 1949 Latin American plant breeders conference meet at Chapingo to inspect improved corn varieties.

From the start the program has received the enthusiastic support of high officials in the Mexican Government, as well as the trustees and officers of The Rockefeller Foundation. Ing. Marte R. Gómez, Secretary of Agriculture from 1940 to 1946, and Ing. Alfonso González Gallardo, Subsecretary of Agriculture during the same period, took personal interest in the program from the beginning, and current accomplishments are largely the result of projects begun with their support and approval. In 1946, after his election to the Presidency of Mexico, President Miguel Alemán V. further endorsed the program and subsequently gave it his sympathetic and enthusiastic support. The present Secretary of Agriculture, Señor Nazario S. Ortiz Garza, and his Subsecretary, Señor Ing. Jesús Merino Fernández, have given continued and increasing support to the program and have made it possible to reach the present level of development.

ORGANIZATION AND SUPPORT

To insure an effective organization for the Mexican Agricultural Program the Mexican Government set up an Office of Special Studies. Because this office is semi-official in nature, functioning as a joint dependency of the Department of Agriculture of the Mexican Government and of The Rockefeller Foundation, it has the freedom to furnish effectively the assistance requested by the Mexican Government. Both of the agencies on which this office depends contribute to the operating costs of the program. Over the six-year period covered by this report The Rockefeller Foundation has allocated about $1,300,000 to the program. The Mexican Government's direct subsidy for general program activities has amounted to 930,000 pesos; in addition Mexico has provided land, labor, office and laboratory space, funds for buildings, certain pieces of machinery, fertilizers and other materials, and has commissioned technical personnel to the program.

PRINCIPLES

The Advisory Committee, in the report which it made to the Foundation in 1941, set forth certain guiding principles of operation and collaboration. Other principles have evolved as the result of experience during the last six years. The following are the chief principles which now govern the organization and activities of the Mexican Agricultural Program.

1. No person is appointed to The Rockefeller Foundation staff engaged in this work who is not regarded as first-rate when judged by American standards. The Advisory Committee felt strongly that the success of this program would be assured if the services of the best young agricultural scientists obtainable in the United States were employed. The Field Director has been in complete sympathy with this principle and has followed it strictly in choosing the members of his staff.

2. No person is appointed to the staff unless he is prepared to make a permanent career of agricultural research abroad. Selection based on this criterion has been so effective that there has been only one resignation from the staff in the entire six-year period.

3. The Rockefeller Foundation personnel, as well as their Mexican col-

The introduction garden at Chapingo offers a preliminary testing ground for new crop plants. The best varieties are then tried out in other climates and soils in Mexico.

Scientists from Mexico, Guatemala and El Salvador working together in the wheat improvement program.

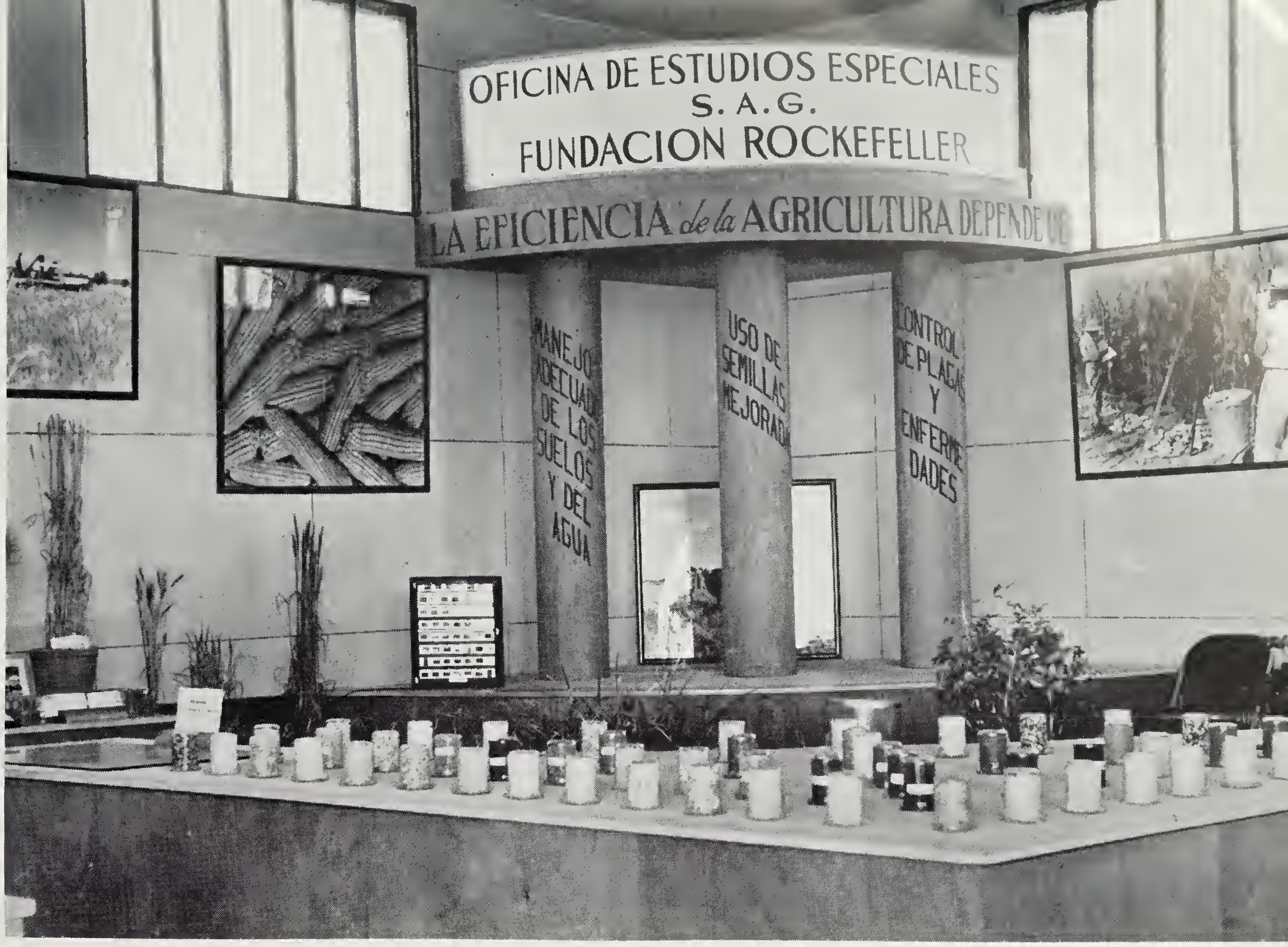
leagues, are organized as a semiofficial government office: one which is an integral part of the Mexican Department of Agriculture, but possesses a high degree of autonomy. This office has the advantage, so important to the ultimate future of the program, of being completely within the structure of the Mexican Government; but it also has the advantage of being largely free, in its operating procedures, from the hampering restrictions which are so often the product of governmental red tape. The Office of Special Studies was officially established in 1944 and given headquarters in one of the principal buildings of the Department of Agriculture.

4. Close cooperation and free exchange of information and of materials with official agencies and personnel of the Mexican Government are accepted as basic premises to effective progress. Every effort has been made to cooperate closely with agencies having similar or related objectives. Mexican organizations with which cooperative relationships have been maintained are the National College of Agriculture; the Institute of Agricultural Investigation; the General Bureau of Agriculture; the Bureau of Agricultural Pest Control; the Bureau of Soil Conservation; the Bureau of Animal Industry; the Corn Commission; the Wheat Commission; and the Nutrition Bureau of the Mexican Department of Health and Welfare.

5. Major effort is concentrated on fundamental research dealing with the soils and basic food crops of Mexico. The Foundation's assistance has been sought time and time again in other agricultural enterprises, including the development of export crops. But the director and the staff have adhered rigidly to the principle that the program is dedicated to the improvement of the Mexican food supply and have felt it necessary to decline all invitations to deviate from this objective.

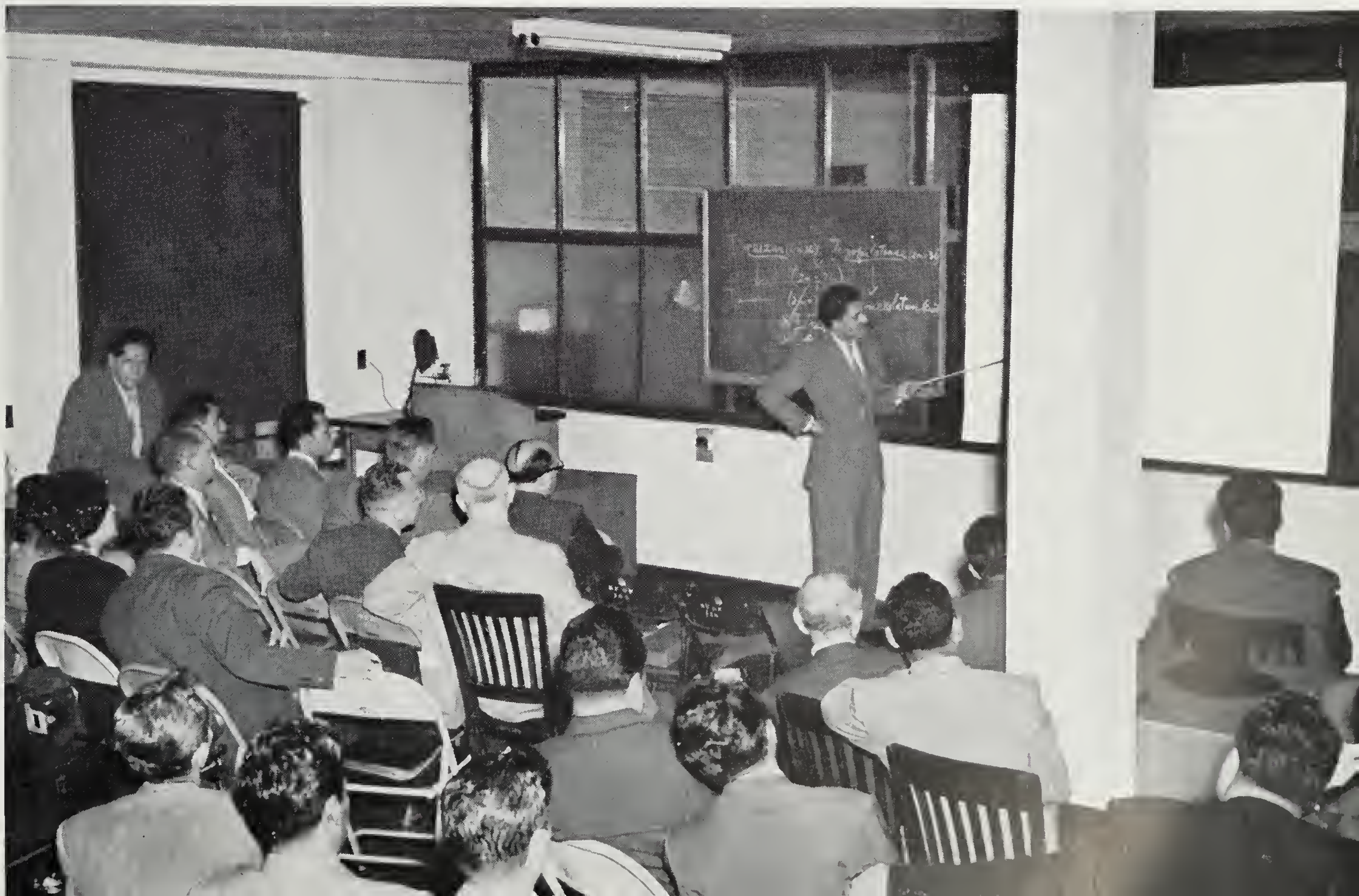
6. The program operates on the principle that the most rapid progress is attained through the widest possible geographical testing and free utilization of all facilities in applying the results. All of Mexico is regarded as a "pilot plant" to determine how new varieties behave under different conditions of soil and climate. Thus far experimental work has been carried on in nineteen states.

7. Results of proven value are utilized at the earliest possible moment. Unlike some experiment stations in the United States which work for ten or fifteen


OFICINA DE ESTUDIOS ESPECIALES
S. A. G.
FUNDACION ROCKEFELLER
LA EFICIENCIA de la AGRICULTURA DEPENDE DE
MANEJO ADECUADO DE LOS SUELOS Y DEL AGUA
USO DE SEMILLAS MEJORADAS
CONTROL DE PLAGAS Y ENFERMEDADES

The booth of the Office of Special Studies at the Presidential Exhibition in the National Stadium, Mexico City, 1949.

Field work is supplemented by conferences. Often of an international character, they help to promote cooperation among Latin American agriculturists.



years to produce the "perfect" new wheat or hybrid corn, the Office of Special Studies believes that there should be a succession of improved varieties and practices, none perfect but each an improvement over the preceding ones. In compliance with this principle new results or new varieties are made promptly available to scientists and farmers. Once the seed of improved crop varieties has been produced in quantity, it is delivered to authorized agencies of the Government for further increase and distribution on a nation-wide scale. There has also been prompt release of information through office bulletins, articles in national and international periodicals and professional theses written by the young Mexican scientists.

8. The program must include intensive training of Mexican apprentices. The ultimate aim of a program such as this is to develop a body of competent native research scientists and teachers who will be able eventually to take complete charge of the numerous activities of a technical program in agriculture. The training involves not only direct participation in all phases of the program but also provision for subsequent study abroad by the most promising young Mexican agricultural scientists.

TWOFOLD PROGRAM

Agricultural problems in Mexico are numerous and complex. Rather than attempt an attack on all or even a major number of these problems the two agencies concerned were in agreement that the program must be limited if it were to be effective. Following formal inception of the program Dr. Stakman went back to Mexico with Dr. Harrar and both traveled widely consulting with Mexican scientists and laying the foundations for the program. They were of course guided by the preliminary report of the Advisory Committee, which recommended initial concentration in the fields of 1) Soils Science, 2) Plant Breeding, 3) Disease and Pest Control and 4) Animal Husbandry.

After intensive study and travel the Mexican and American specialists decided on a twofold program. The central activity was to be fundamental research on methods and materials valuable to increased production of Mexico's basic food crops. But since this program must eventually be wholly Mexican it was planned that the second major emphasis consist of a training program for selected Mexican scientists.

The young men who have already completed their training with the Office of Special Studies form the core of an ever-increasing body of serious, well-prepared agricultural investigators and teachers who have set themselves the continuous task of increasing the scope of agricultural research in Mexico. On the success of these two phases of the Mexican Agricultural Program—the improvement of basic food crops and the training of young scientists—hinges the solution to many agricultural problems of nation-wide importance.

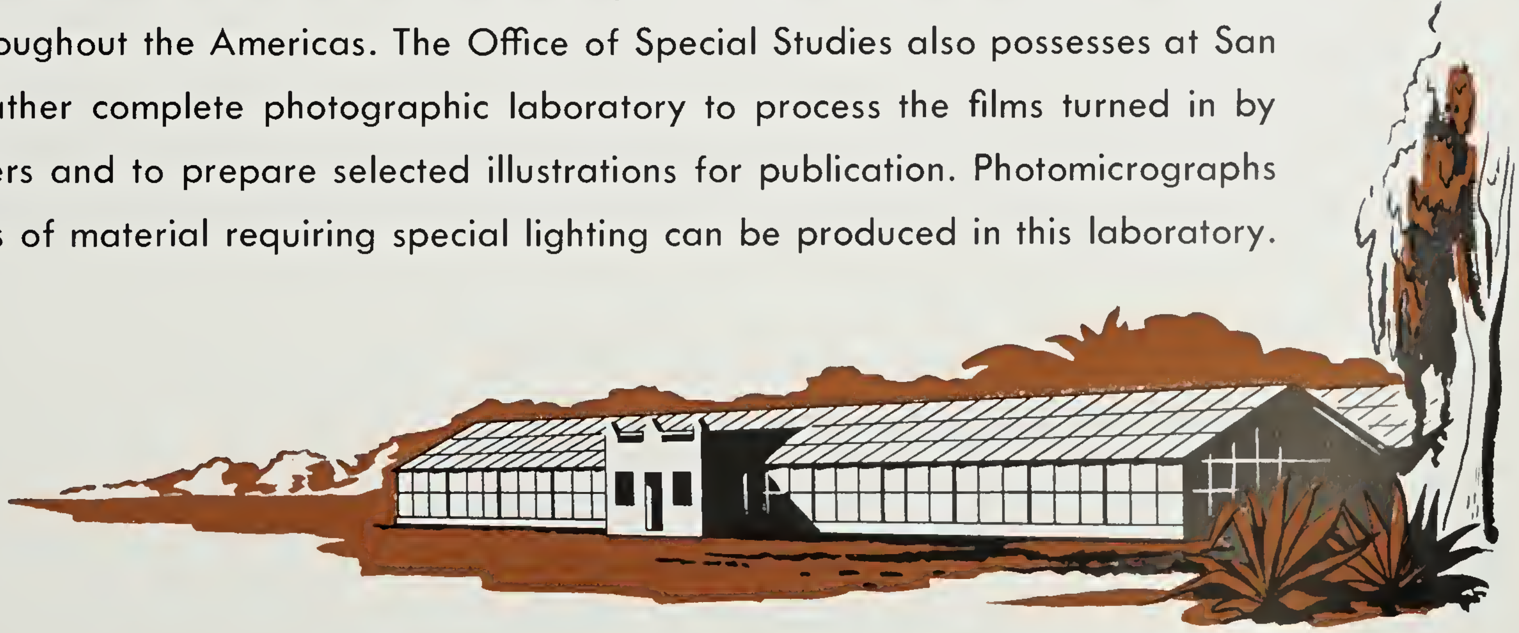
Although work in animal husbandry had been recommended in the reconnaissance of 1941, it seemed advisable to devote first efforts to the more urgent needs of crop production, which are in themselves basic to sound livestock raising.

THE OFFICE OF SPECIAL STUDIES

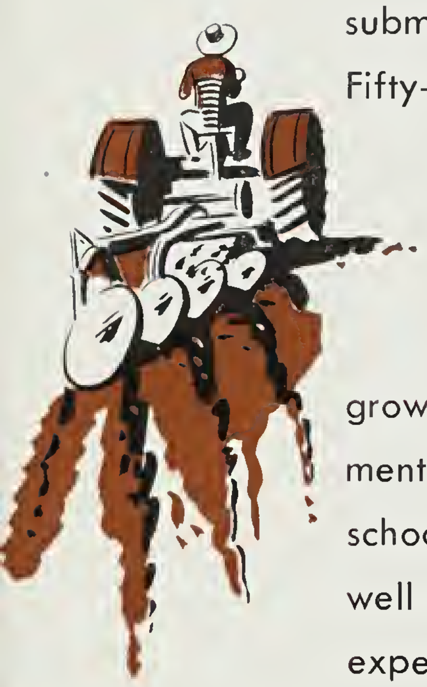
The main administrative offices and several auxiliary laboratories of the Office of Special Studies are housed in the building of the General Bureau of Agriculture located in San Jacinto, a northwest suburb of Mexico City.

Although the bulk of the research activities are carried on at the central experiment station, to be described later, the laboratories at San Jacinto are an essential adjunct to field work in plant pathology and entomology. Exhibit rooms attract Mexican farm owners and visiting scientists from many parts of the hemisphere. Here also is an herbarium containing dried specimens of plant materials collected all over Mexico and in many neighboring countries.

In addition to offices and research laboratories, the Office of Special Studies operates two services of importance. In 1945 there was started an agricultural library. Now the most complete collection of its kind in Mexico, and one of the leading agricultural libraries south of the Rio Grande, it serves not only staff personnel but other scientists from organizations all over the country. It maintains exchange relations with libraries throughout the Americas. The Office of Special Studies also possesses at San Jacinto a rather complete photographic laboratory to process the films turned in by staff members and to prepare selected illustrations for publication. Photomicrographs and pictures of material requiring special lighting can be produced in this laboratory.



The Mexican Agricultural Program regularly prepares reports of its activities. Some of these are office bulletins or unpublished reports submitted semiannually by the Field Director to the Department of Agriculture and to The Rockefeller Foundation. From time to time, however, the Office of Special Studies publishes papers in international journals or local agricultural publications. Technical papers, usually theses submitted toward professional degrees in agriculture, are also published occasionally. Fifty-two publications of various types have now been issued by the program.

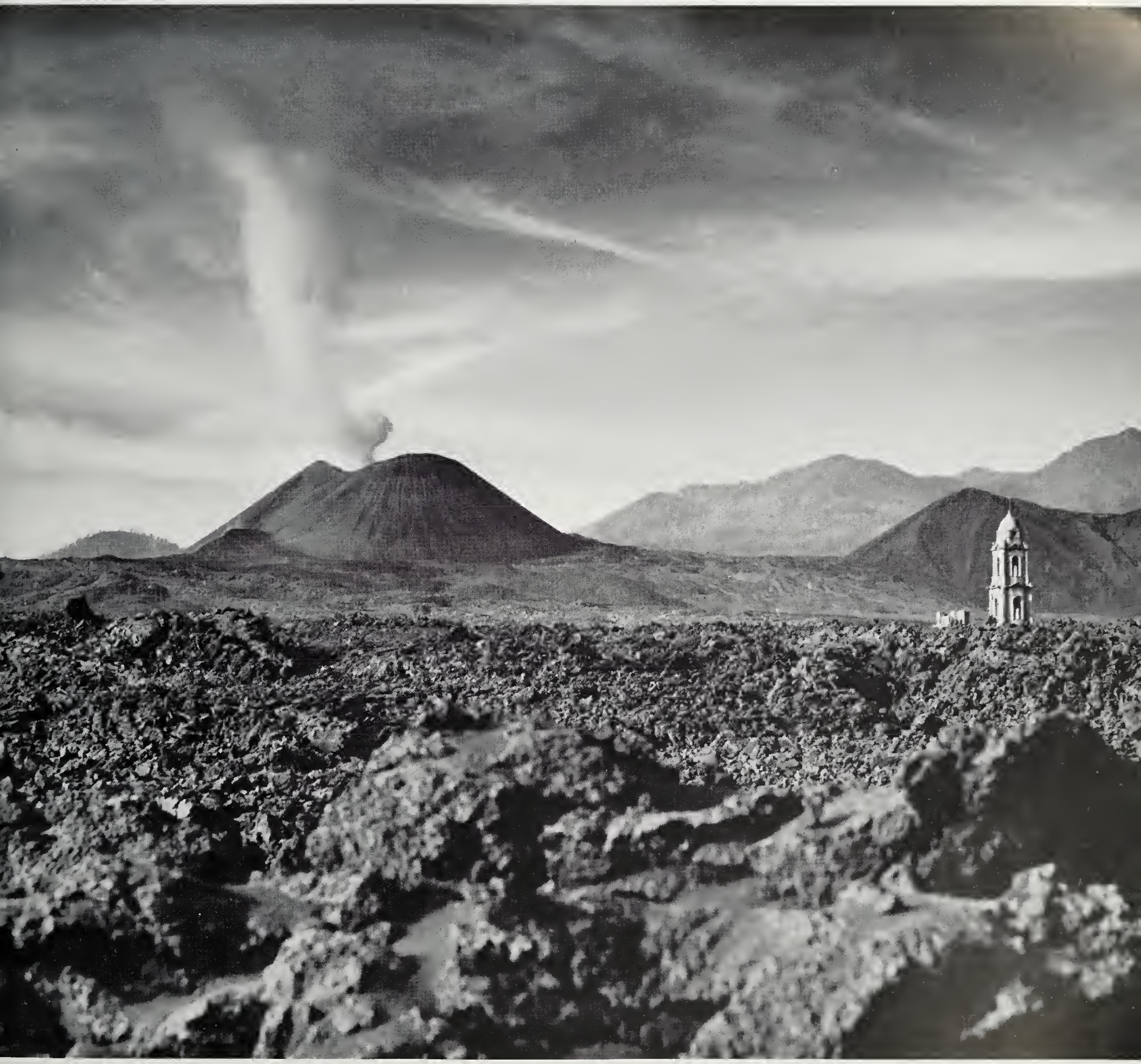


EXPERIMENT STATIONS

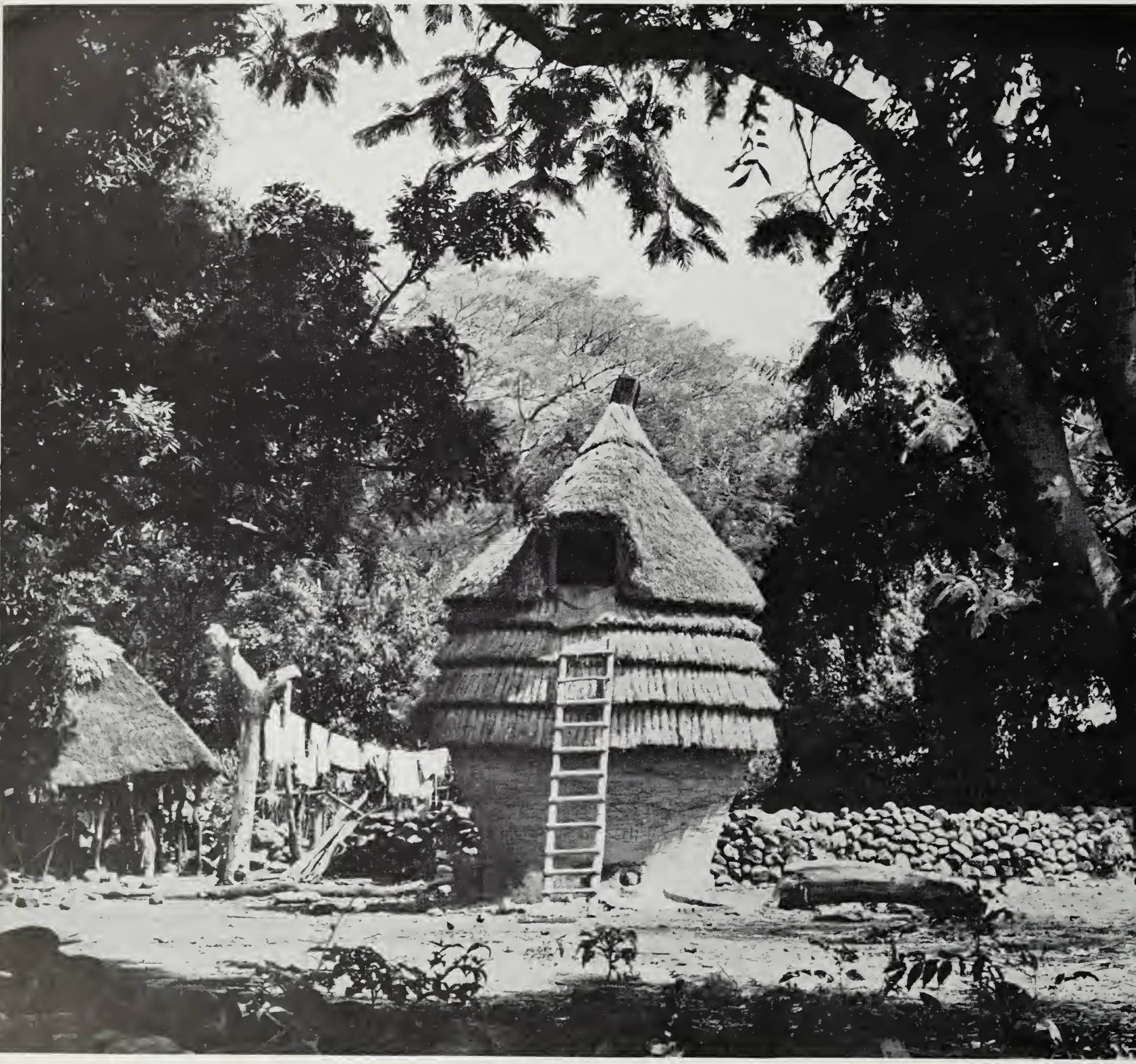
Field work for the Mexican Agricultural Program is carried on in crop-growing regions scattered throughout the country. Wherever possible, federal experiment stations are used, but experiments have also been conducted in cooperation with schools of agriculture, the Bureau of Soil Conservation and the Corn Commission, as well as with many hacienda owners and small farmers who have offered facilities for experimental work. At present work is carried on in the States of México, Morelos, Puebla, Tlaxcala, Guanajuato, Querétaro, Jalisco, Michoacán, Nayarit, Chiapas, Aguascalientes, Durango, Chihuahua, Sonora, Veracruz, Zacatecas, Coahuila, Oaxaca and Nuevo León, as well as the Distrito Federal. During 1948, for example, over 500 experiments were established in various parts of the Republic.

The heart of the agricultural program is its central experiment station located on the grounds of the National College of Agriculture in Chapingo, some 25 miles east of Mexico City. During the six years of the program a number of field laboratories, greenhouses and scientific planting projects have been developed by the Mexican Government and Foundation personnel. The research facilities are comparable to those at leading agricultural experiment stations in other countries. The staff is composed of experts in all phases of scientific agriculture: soil chemists, geneticists, microbiologists, plant pathologists, entomologists, ecologists and agricultural engineers.

The station at Chapingo was the first to be established directly by the Mexican program. Another new station has now been started in the State of Guanajuato, north of Mexico City, and a third is operating in the State of Morelos, which is sub-



A land rich in volcanoes, Mexico owes much of her topsoil to lava flows. The new volcano of Parícutin, which erupted from a cornfield in 1943, engulfed thousands of acres of cropland. A few hardy farmers have now resumed corn-raising on the edges of the lava field.



This corn granary built of clay and straw imitates prehistoric types. It is a common structure in the State of Morelos.

tropical and enables the corn breeders to grow a second generation of corn in the winter. This area is also valuable for studies in entomology, pathology, soils and crops.

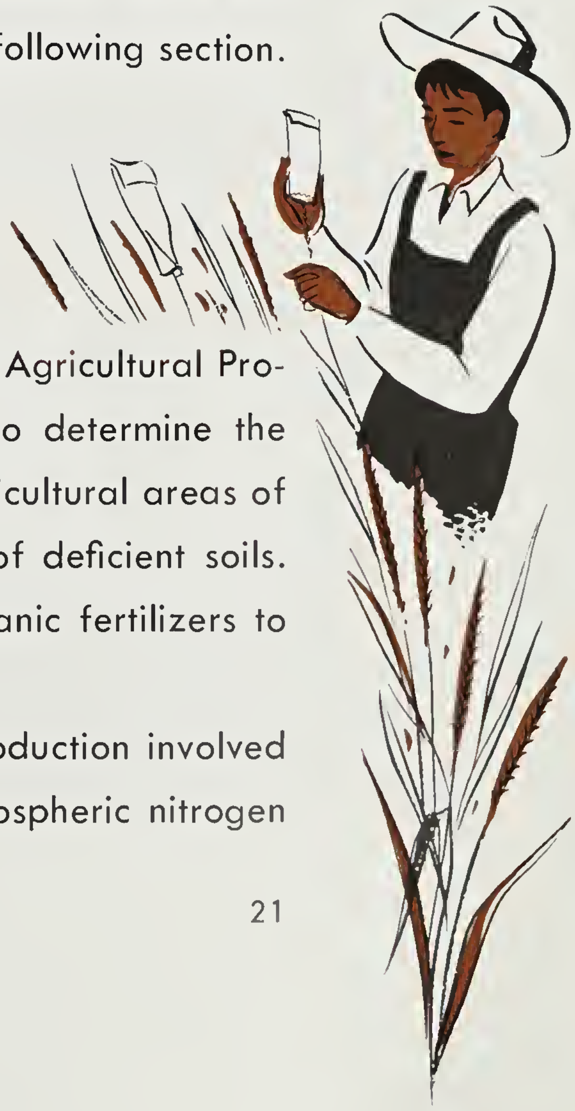
Chapingo is the scene of much important experimental work. Its 260 acres of experimental plots are the birthplace of new hybrid and synthetic corn varieties and new disease-resistant varieties of wheat. Disease and pest control methods and soil management are other subjects of intensive research and planning here. The wings of the field laboratory, recently constructed through the joint efforts of the Mexican Government and The Rockefeller Foundation, house seed rooms, a seed dryer, machinery for fertilizer, insecticide and fungicide preparation and a soils laboratory. In the patio there is space for threshing, shelling, seed treatment and other experimental operations. Another new building houses farm machinery.

Because plant introduction and testing become increasingly important as the program advances, a large introduction garden has been established at Chapingo. Preliminary testing of plant materials is made here. Selected varieties may then be sent to other parts of the Republic for further trial or be planted again for seed increase.

Twenty-four improved varieties of corn, eight improved varieties of wheat and seven superior kinds of beans have already been released by the program. Several varieties of legumes and sorghums are currently undergoing multiplication. More details about these improved varieties will be found in the immediately following section.

THE RESEARCH PROGRAM

SOIL AND CROP STUDIES



Some of the first projects to be undertaken by the Mexican Agricultural Program were concerned with soils. Staff specialists made analyses to determine the physical and chemical characteristics of the soils in the important agricultural areas of Mexico and to ascertain mineral and organic matter requirements of deficient soils. With that information in hand they began to experiment with inorganic fertilizers to find the best compounds, rates, times and methods of application.

Another means to soil improvement and increased crop production involved the introduction and testing of green manure crops, which add atmospheric nitrogen and organic material to poor soils. Clovers, alfalfas, soybeans, vetches, beans, peas and lupines have been tried out on various soils. Sometimes they were rotated with corn and wheat; sometimes they were grown in association with these crops. Projects bearing directly on rotation are also a part of the program. These help to ascertain the most efficient rotation patterns under specific environmental conditions in Mexico.

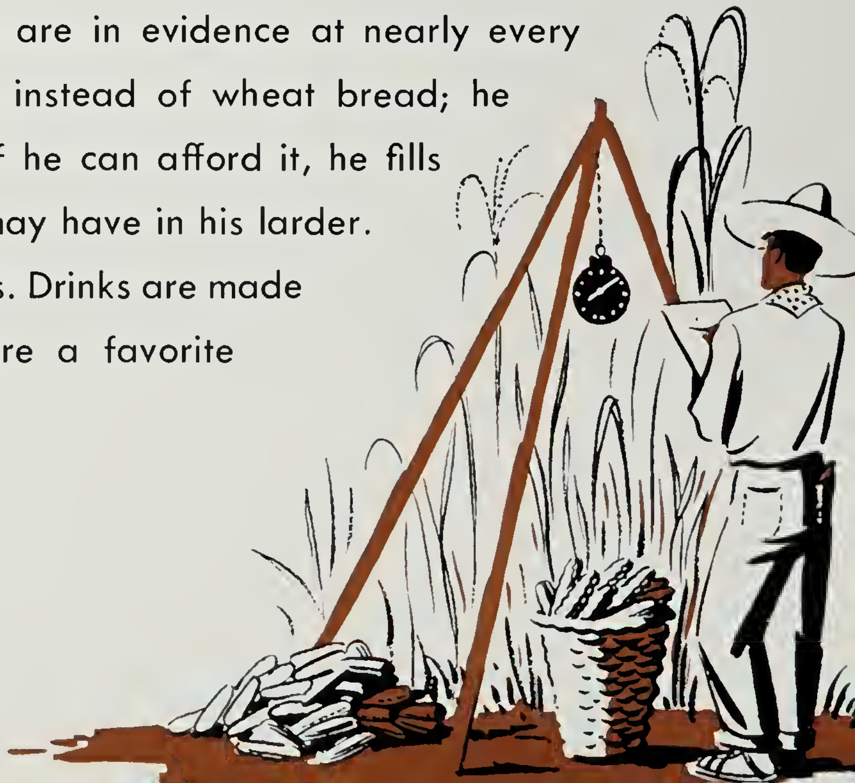
Several new crops of potential value in Mexican agriculture are under cultivation. Species of grasses, and varieties of sorghums, soybeans, Hubam and other clovers, vetches and some types of peas and beans are being grown for the first time under test conditions.

Practical benefits have already accrued from these soil investigations. The application of commercial nitrogen and phosphorus has been recommended for certain wheat and corn areas. Other researches showed that shade-tolerant green manure crops, when interplanted with corn and wheat and allowed to develop a full cover after harvest of the cereal crops, will aid in weed control; they go on working when turned under because they supply valuable nitrogen and organic matter to the soil. The use of green manure crops in pure stands is increasing also, largely as the result of a campaign launched by the Department of Agriculture.

Weeds are a plague to farmers the world over. In Mexico they are of paramount seriousness in certain types of agriculture. The Mexican Agricultural Program has a special project on weed killers, and some of the chemical herbicides whose efficacy it has demonstrated are being used to advantage in commercial wheat production.

CORN

The heart of the research program for the present is corn improvement. As is quite generally known, the Mexican people in an almost literal sense live on corn. Tortillas made from a dough of ground corn are in evidence at nearly every meal. The humbler Mexican regularly eats tortillas instead of wheat bread; he uses them as scoops for soup and chili sauce, or, if he can afford it, he fills them with cheese, meat, beans or anything else he may have in his larder. The tender young ears, cobs and all, are used in soups. Drinks are made of emulsified corn. The roasting ears, "elotes," are a favorite



Improved varieties of corn are increasing yields in Mexico. Several open-pollinated varieties and some new synthetic and hybrid corns have already been released to farmers for large-scale planting.

vegetable, and no market is complete without at least one vendor of green corn. The crowds at the bullfights refresh themselves after the performance with succulent ears of boiled corn. This Indian maize is the national food.

The result is that virtually every Mexican tries to raise a patch of corn. Approximately 58 per cent of Mexico's cropland is given over to corn. When the members of the Advisory Committee went down to Mexico in 1941 they were impressed with the wide range of conditions under which corn can be grown. They saw cornfields at sea level, in mountain passes 10,000 feet above sea level, in poor soil, in rich soil, in dry regions and in semiarid and humid regions. They even found corn planted between rows of bananas and pineapples. They saw it sprouting between rock crevices on slopes so steep that any farming seemed fantastic. Wherever its seed would germinate and find a bit of soil for its roots, corn was growing.

Nevertheless, Mexico does not produce enough corn. In fact corn production has been declining steadily for many years. When the program started the average yield of corn was less than ten bushels an acre in contrast to the then average of twenty-five in the United States. Many factors, including primitive cultivation methods, were keeping the Mexican corn harvest poor in both quantity and quality. Additional corn had to be imported.

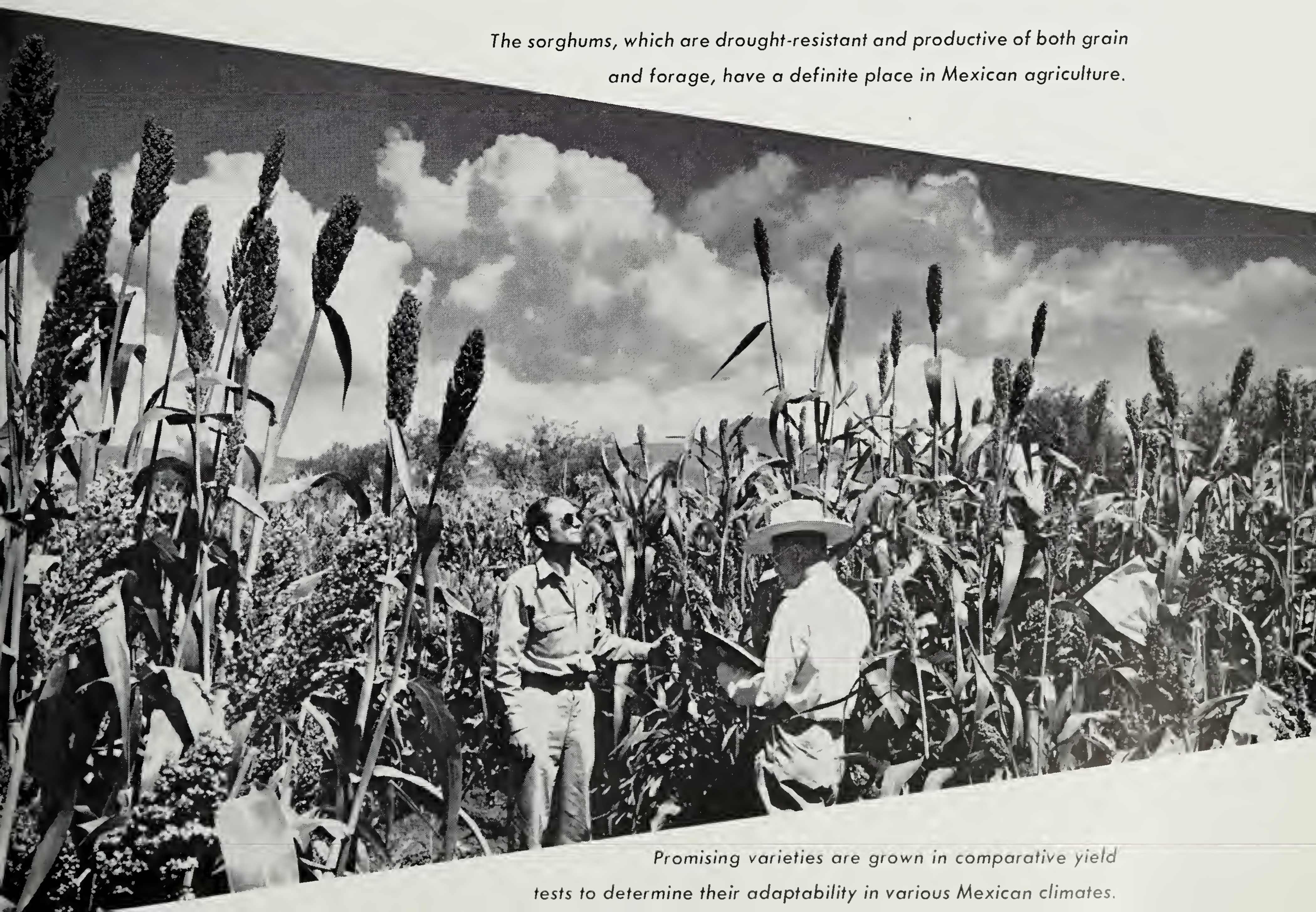
The corn experts of the agricultural program first of all made a point of visiting all the corn-growing regions in the Republic. To the central experiment station at the College of Agriculture in Chapingo, they brought back seeds of more than a thousand varieties of native corn. They had many questions. Which were the best yielders, which matured early, which were high in nutritive value, and how did each adapt in different climates and on different soils? To get answers to some of these questions they planted their seeds not only in Chapingo but in experimental plots all over the Republic. At the same time, they planted seeds sent from the United States, Guatemala and other corn-growing countries.

This preliminary testing gave them a basis for selecting a few good varieties for seed increase. The superior open-pollinated varieties first released for multiplication were intended for immediate utilization and were promptly given out to Mexican farmers for planting.

Then the scientists began to breed new kinds of corn. They knew that each variety of the good native corn was superior in certain respects but not in all, so they developed synthetic and hybrid varieties. The synthetic varieties came first because they could be developed quickly and at reasonable cost, while the breeding of hybrids was in progress. Hybrids are the best yielders, and currently double-cross hybrids are being increased and distributed.

The improved varieties so far given to Mexican farmers include four open-pollinated varieties, eight synthetics and sixteen hybrids, all of which are superior for yield and resistance to disease.

The corn improvement project has had important accessory benefits. Primarily, it brought about the establishment of one of the largest and most varied corn collections in existence, certainly the most extensive collection ever made from one country. As such, it offers material for fundamental studies of corn types and the clarification of genetic problems.



The sorghums, which are drought-resistant and productive of both grain and forage, have a definite place in Mexican agriculture.

Promising varieties are grown in comparative yield tests to determine their adaptability in various Mexican climates.

These new wheats for Mexico combine the desirable characteristics of several different varieties. The two pictured above are being grown for seed increase.

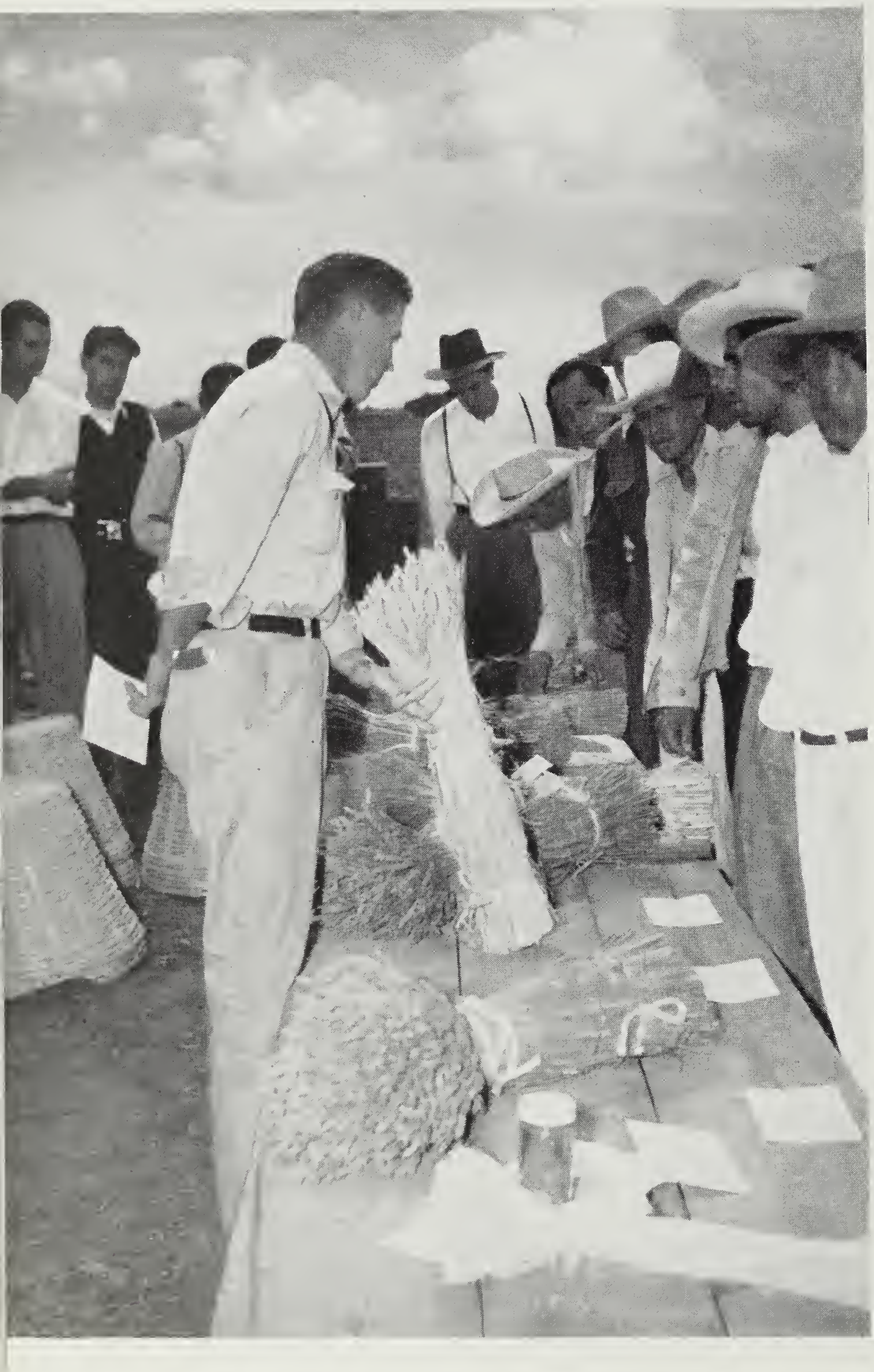
In 1949 something like two thirds of a million acres were planted to the improved varieties of corn. This includes not only the acreage planted under the supervision of the Corn Commission, but also additional large amounts planted with seed distributed locally by private farmers to their friends and neighbors. It was estimated that the 1948 crop, for which only 500,000 acres were planted in new varieties, had been increased, thanks to the improved types, by 125,000 tons. In 1948, for the first time in thirty-five years, Mexico did not have to import corn. In the not too distant future, not only will there be enough corn for all the people but perhaps there will also be some for feeding to livestock, thereby improving the supply of meat and milk.

WHEAT

While the wheat improvement research has followed much the same pattern as that for corn, the big problem in wheat was to find or develop varieties which would resist fungus diseases. Wheat rusts have cost Mexico millions of dollars annually. In certain regions the rust epidemic has at times been so severe that the farmers had to burn their crops. Because rusts flourish in the moist summer weather, the Mexican farmer, up to now, has always been obliged to grow his wheat in winter. Then, however, it is so dry that irrigation is needed.

The wheat project has already relieved this situation by producing twelve new varieties suitable to the Mexican climate. Of these, eight have already been grown for seed increase and turned over to farmers for planting. In the fall of 1947 the program released six tons of the improved, rust-resistant wheat. The Wheat Commission has multiplied this many times. In the fall of 1949 some 4,500 tons were ready for planting. This will seed approximately 110,000 acres, or about 8 per cent of the total wheat acreage of Mexico. Within one year more, there should be improved wheat to seed something like three fourths of the wheat acreage.

The chief virtue of the new varieties is their resistance to disease, especially to stem and leaf rusts. They can be grown not only in winter but also in the summer rainy season. In addition they possess satisfactory qualities with respect to yield and milling and baking characteristics.



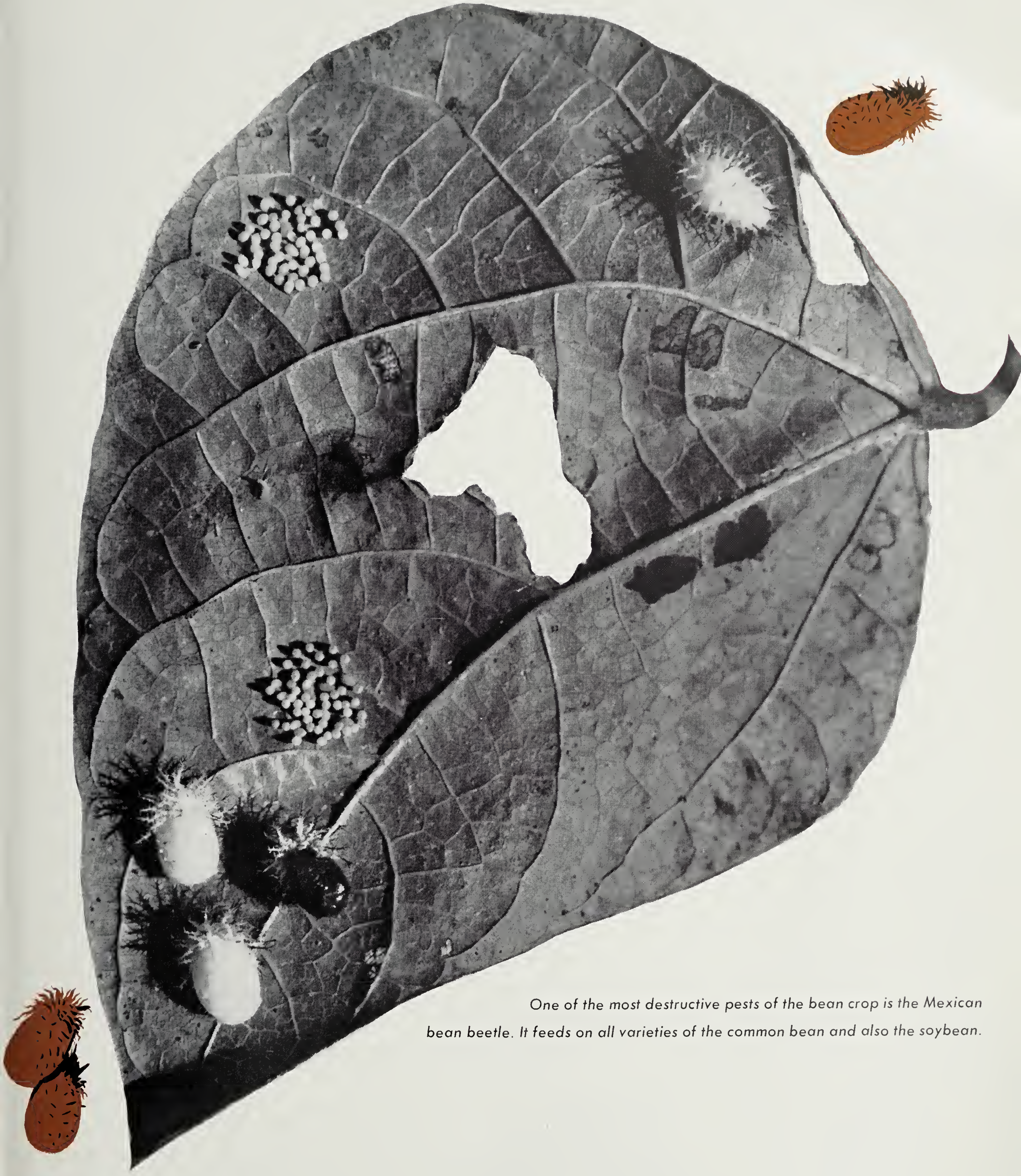
Improved wheat varieties on display at a field day organized by the Office of Special Studies.

Recently plans have been made to establish agricultural credits up to fifteen million pesos to bring new land areas into wheat production. The general use of the new varieties already released and of the still better ones now being increased should result in significantly higher wheat production for Mexico.

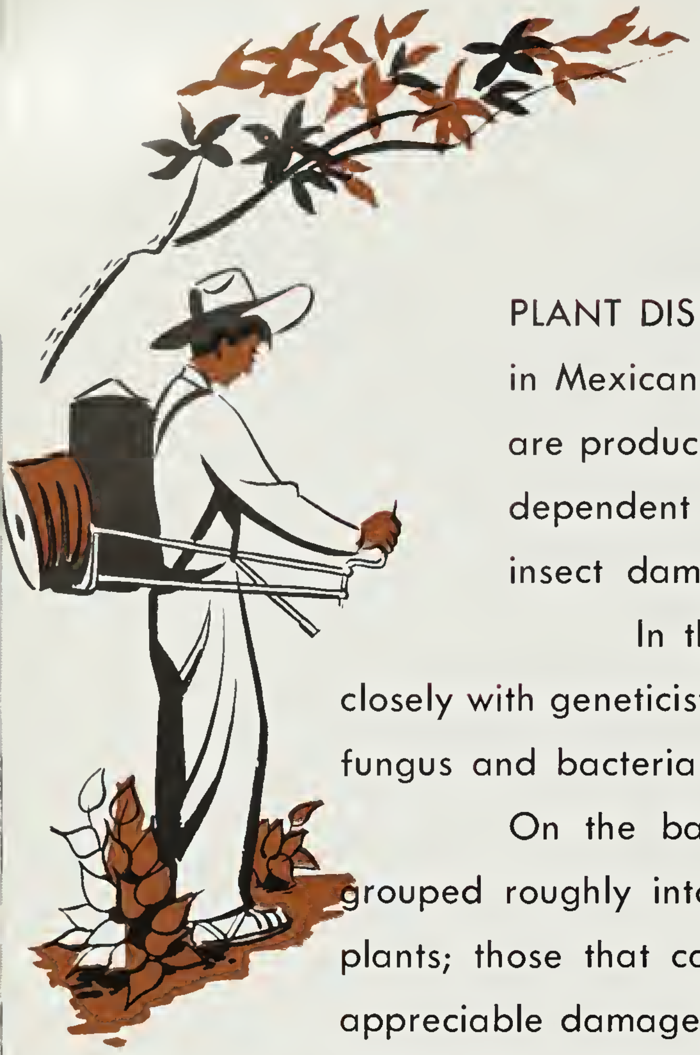
BEANS

Beans of various kinds constitute the second most important crop in Mexico, not only from the standpoint of the total acreage devoted to their cultivation but also because of their place in the diet. For the poorer classes, to whom meat and milk are luxuries, beans are the chief source of protein.

While bean improvement is secondary to the work with corn and wheat, a great number of bean varieties have been grown in test plots. Seven varieties have been selected for their superior yield and their resistance to disease and pests. The seed is being grown for multiplication and distribution. Other good varieties will be used in the breeding program.



One of the most destructive pests of the bean crop is the Mexican bean beetle. It feeds on all varieties of the common bean and also the soybean.



PLANT DISEASES Plant diseases and insect pests are major obstacles in Mexican agriculture. Every year they take a heavy toll. Even when crops are produced from good seed and on fertile land a high yield is in the end dependent on better understanding and intelligent control of disease and insect damage.

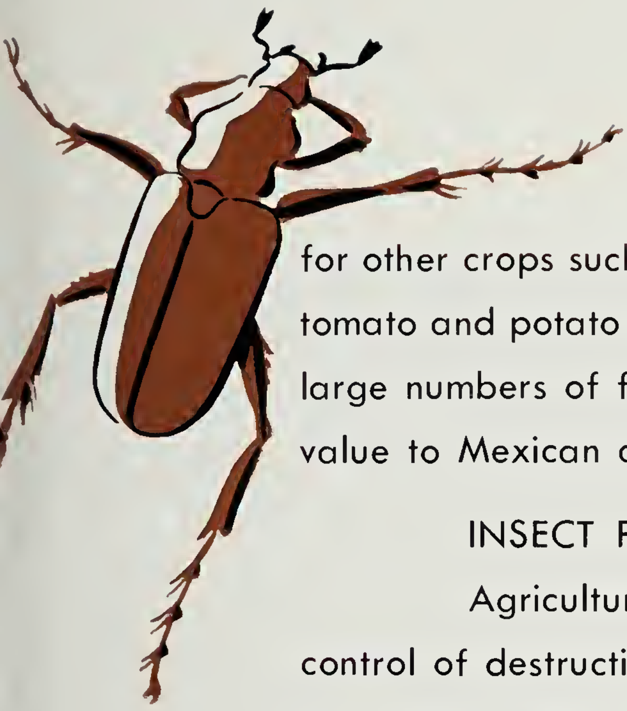
In the Mexican Agricultural Program plant pathologists are working closely with geneticists: one group identifying and seeking remedies for blights and for fungus and bacterial diseases, the other developing disease-resistant crop varieties.

On the basis of their destructiveness, plant diseases in Mexico may be grouped roughly into four categories: those that threaten to eliminate certain crop plants; those that cause devastating seasonal or regional epidemics; those that do appreciable damage annually; and those that are unspectacularly debilitating in that they take the profit out of farming.

The rust of wheat and other cereals, caused by a fungus, is especially dangerous because it spreads so easily. It may sweep throughout the grainlands and even spread to other countries. In the past it has been a severely limiting factor in wheat production. Proper timing in seeding to prevent an overlap of the latest ripening winter wheat and the earliest sown summer wheat helps to prevent survival of the parasite but does not eliminate it completely. The best approach—the development of new rust-resistant varieties of wheat—is the one that has been adopted by the Mexican Agricultural Program.

The smuts of wheat and barley are examples of rather easily preventable diseases that cause important losses every year. Also caused by fungi, they are transmitted on or in the seed. Fungicidal treatment of the seeds takes care of infection on the surface of the seed; however, other methods must be worked out for organisms within the seed.

Root rots are probably the most important diseases of both corn and beans. Their effects are damaging rather than devastating. At present all the chief lines and varieties of beans and corn used in the breeding program are tested for resistance to these pathogens. Experiments are also under way to determine whether the same species of rots which cause serious losses in beans are also pathogenic for corn, and



for other crops such as lima beans and chilies. Diseases of economic importance to the tomato and potato crops are also under study. Different methods of soil treatment and large numbers of fungicides and spray and dust practices have been tested for their value to Mexican agriculture.

INSECT PESTS Entomological researches carried on by the Mexican Agricultural Program have already yielded valuable information on the control of destructive pests, such as Mexican bean beetles, Apion bean-pod weevils, fall army worms, crickets, corn thrips, billbugs and others. In some regions white flies, leaf hoppers and an unidentified lepidopterous pod insect may also require control measures.

As with the plant diseases, first efforts were directed at the identification of pests of economic importance. Biological studies are made of each insect, and new crop varieties developed within the program are submitted to thorough tests for reaction to these pests. Considerable attention has also been given to insect vectors of some of the plant diseases.

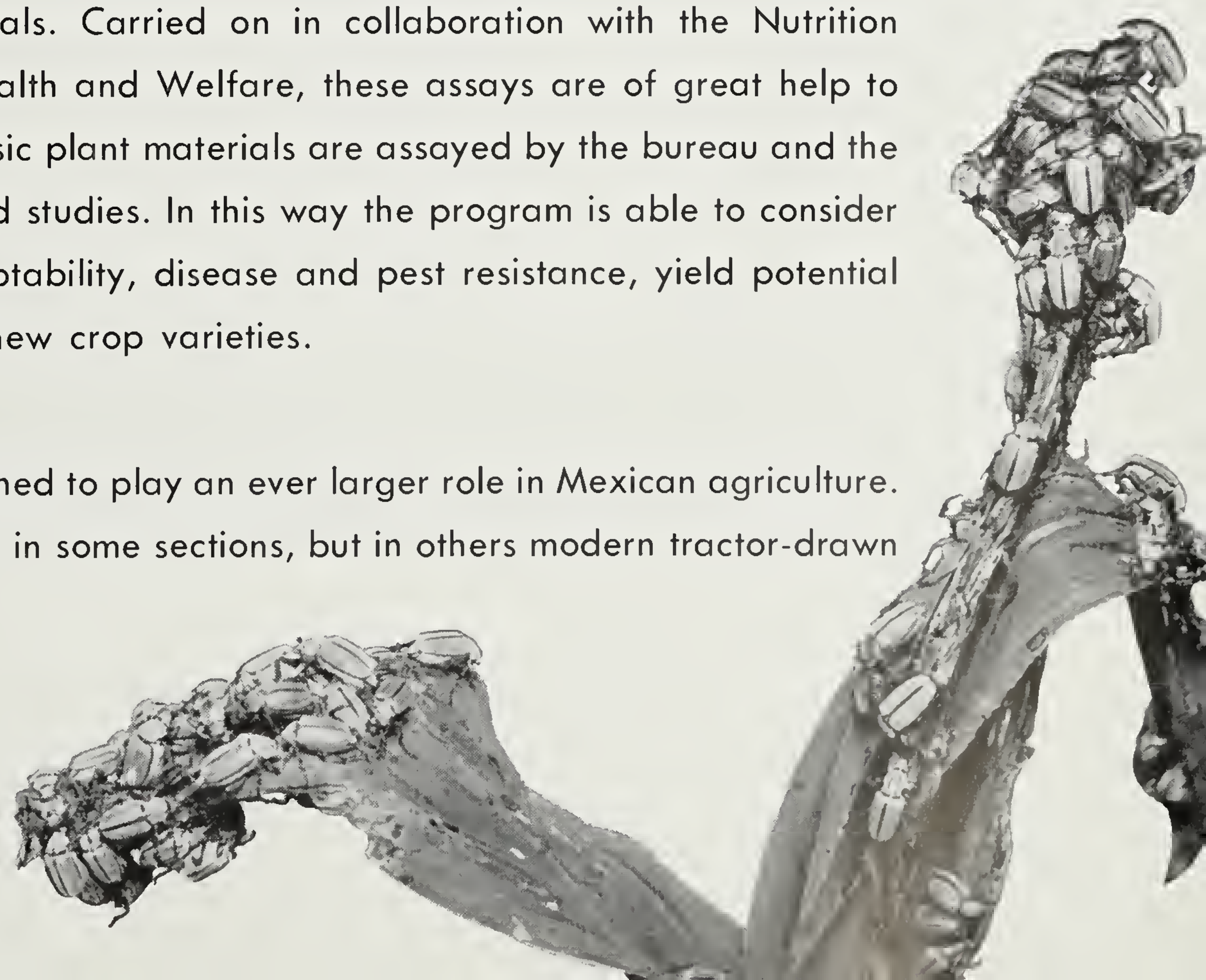
A significant portion of the project is devoted to experiments with insecticides and the development of dust and spray techniques for use both in the field and in granaries. When the insect pests of a specific crop are known, control experiments are made in order to establish treatment schedules.

AGRICULTURE AND NUTRITION

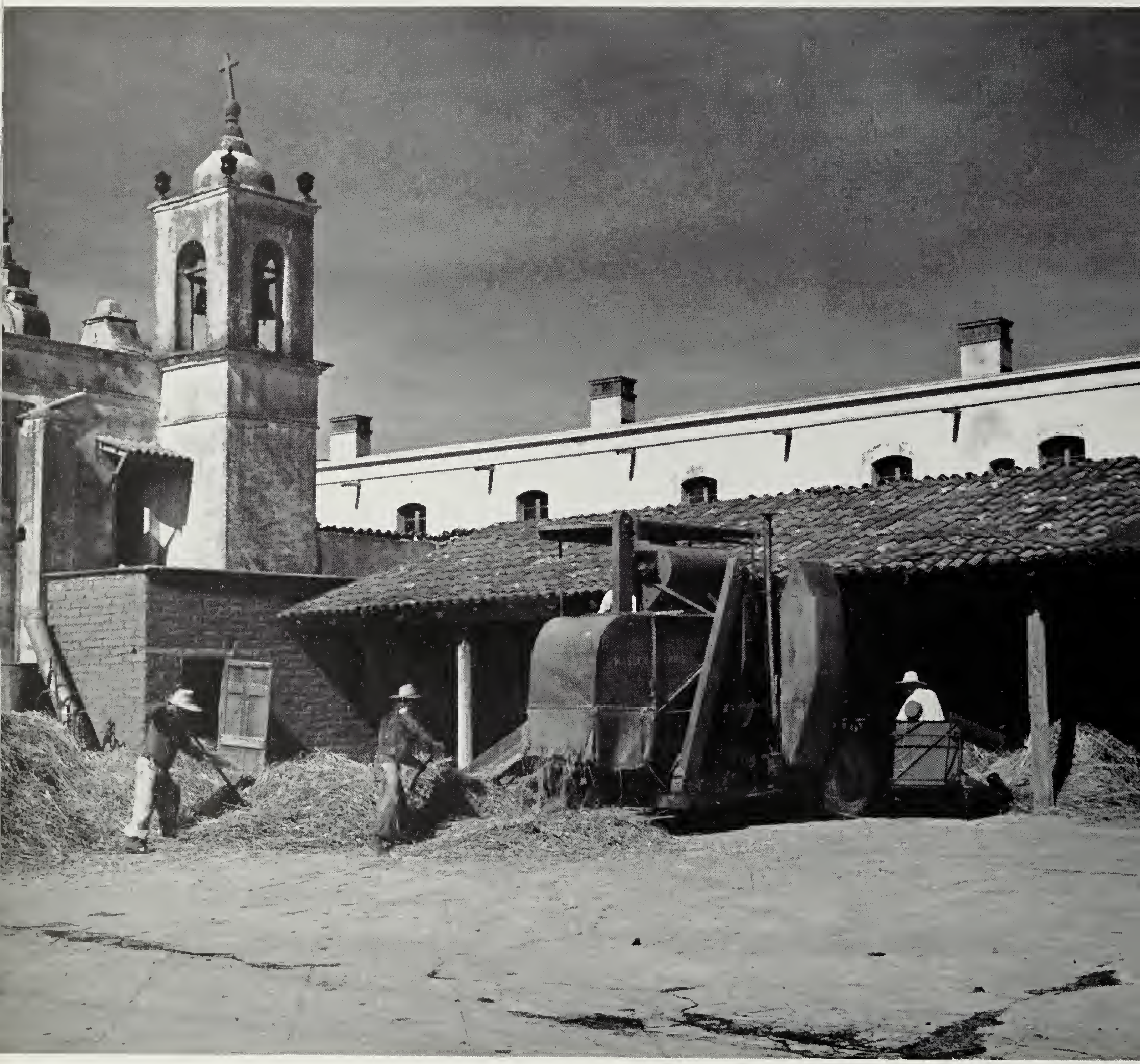
An example of close cooperation with other agencies is the work on biochemical assays of food materials. Carried on in collaboration with the Nutrition Bureau of the Department of Health and Welfare, these assays are of great help to the plant geneticist. All of the basic plant materials are assayed by the bureau and the results then coordinated with field studies. In this way the program is able to consider nutritional value along with adaptability, disease and pest resistance, yield potential and other qualities in selecting new crop varieties.

FARM MACHINERY

Farm machinery is destined to play an ever larger role in Mexican agriculture. Tillage practices are still primitive in some sections, but in others modern tractor-drawn



By consuming corn pollen the rose chafers may reduce the seed set in hybrid corn by as much as 80 per cent.



Threshing wheat in the patio of a large hacienda near Toluca in the State of Mexico.

implements are in common use. Since the introduction of improved implements usually leads to better management methods, the program has devoted a good deal of time to studies of farm machinery. The point here is to achieve an over-all coordination of plant materials, farming techniques and economics. Small plot machinery, commercial leveling and irrigating machinery, as well as plows, cultivators, grain drills and planters, dust and spray equipment, seed driers and graders are all being tested.

AGRICULTURAL EXTENSION

Agricultural extension is an essential feature of the Mexican Agricultural Program. It is the channel through which the results of research can be brought directly and quickly to the farmer. At the very beginning of the program the Mexican Government gave considerable thought to this subject and assigned over-all responsibility for agricultural extension to the General Bureau of Agriculture. The Rockefeller Foundation has cooperated by supplying certain extension facilities and the services of an extension specialist. In January 1947, when the program was far enough advanced to release improved seed in quantity, President Alemán set up a national Corn Commission, whose assigned task was to put the new corn varieties in the hands of the farmers. Later on a similar commission was appointed by the Department of Agriculture to supervise the increase and distribution of improved wheat and other seeds. Under this system the farmer is encouraged to exchange the seed of old native grain varieties for improved seed.

One of the requisites, of course, is to educate the farmer in good use of the improved seeds, and later on there may be a place for local crop improvement associations. Meantime the two commissions are helping to instruct the farmers in approved tillage methods, disease and pest control and irrigation. The General Bureau of Agriculture has instituted series of field meetings in the agricultural regions, and these have been successful in demonstrating new techniques. Educational films are often shown at the meetings, and practical information bulletins are available for distribution.

The Mexican farmer, for all of his respect for tradition, is not hard to convince, once he sees a definite result. When he has compared the new corn varieties

A field day at The Rockefeller Foundation experiment station
in Chapingo brings large numbers of interested farmers together to learn about potato diseases.

with his own, he passes the word along to his neighbors, and demands for improved seed begin to pour in. Last year the Corn Commission provided additional incentive by offering a prize for the greatest yield increase. The prize—a Ford tractor—went to a young farmer who had harvested 125 bushels of corn per acre.

Another interesting propaganda device which the Corn Commission used this year was a new ballet based on the legend of the Aztec corn goddess. A troupe of young dancers from the National Ballet toured the corn belt, giving representatives of the Corn Commission an opportunity to spread word of the improved seed to large numbers of farmers.

TRAINING PROGRAM

The second major activity of the Mexican Agricultural Program is the training of Mexican agricultural scientists. Each year the Department of Agriculture assigns a group of fifteen or sixteen promising young men to work with the Office of Special Studies. For the most part these men are graduates of one of the leading agricultural or technical institutions in Mexico. During a period of one or more years they participate directly in the field and laboratory work gaining practical experience and technical information in their special fields of interest. The majority of them write dissertations in fulfillment of requirements for professional degrees.

Additional training opportunities have been provided by The Rockefeller Foundation for those of the trainees who obtain professional degrees. Students who, after a year or more with the program, show aptitude for research and have acquired a reasonable fluency in the English language are considered for scholarship study abroad. Candidates are selected by mutual agreement of the Department of Agriculture and The Rockefeller Foundation. They are then assigned to spend at least one year studying in another country in the institution which best suits their individual needs. The understanding is that they will return to Mexico to fill posts as agricultural researchers in government service.

By the end of 1949, twenty-six scholarships of this type had been awarded. Eighteen of the scholarship holders have now returned to Mexico, and all occupy responsible positions in agricultural development, research and education.

A limited number of foreign scholars have had an opportunity to participate in the training program in Mexico. So far, twelve students from Colombia, three from Guatemala, one from Honduras, one from Bolivia and six from the United States have spent periods of six months or more in the program by arrangement with the Office of Special Studies. At the request of the Pan American Sanitary Bureau three more Latin American agronomists were trained for posts in the Central American Nutrition Institute. They came from Guatemala, Honduras and El Salvador and were supported by a grant from the Kellogg Foundation.

The training activities are perhaps the most significant and far-reaching feature of the Mexican Agricultural Program. Their success may be attributed in part at least to the policy of helping trainees to participate in an active and functioning program of agricultural research. As the program advances it seems likely that even more time can be profitably devoted to training of personnel from Mexico and other Latin American countries.

Invariably those who have passed through the training period have gained not only additional technical knowledge but a broader view of Mexico's agricultural problems. Without exception the seventy-nine individuals commissioned to the program since its inception in 1944 are today rendering real service to agriculture through research and through the teaching of still younger scientists. The Mexican Government is making a special effort to increase opportunities for well-trained agriculturists, stimulating them to pursue useful careers in agriculture. This growing body of eager, young, competent scientists form the vanguard of future agricultural progress in Mexico. And the association of young scientists from several different American countries is bound to be of help in solving international agricultural problems.

Date Due